

New Alkali Metal Flow Battery for Terrestrial and Aerospace Energy Storage Applications

Completed Technology Project (2012 - 2012)



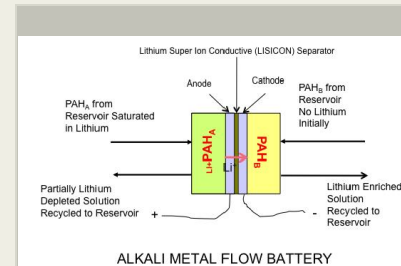
Project Introduction

This seedling task is to develop new lithium-based flow batteries that will provide several fold improvements in specific energy, cost, simplicity and lifetimes, compared to the state-of-art energy storage technologies for planetary habitats as well as terrestrial applications (stationary needs, grid storage, and transportation). These new 'flow' batteries utilize a "liquid" anode, i.e., lithium naphthalenide solution and a high-energy, soluble organic or inorganic permiable membrane.

Renewable energy sources, including wind and solar, can supply a significant amount of electrical energy globally, but their potential has not been fully exploited yet, due to their intermittent nature, which requires safe, cost-effective, and reliable electrical energy-storage systems. Such storage systems will also be critical to improve the robustness and efficiency of the electrical distribution grid by reducing power surges and balancing the load over time. Electrochemical energy-storage devices, i.e., batteries and fuel cells, are promising because of their scalability and versatility, but most fuel cells cannot be reversed electrically (i.e., charged) efficiently. Consequently, batteries, especially flow batteries, wherein the energy density can be increased independently of power density, remain as the preferred option for large-scale energy storage. Several types of flow batteries, i.e., including true redox systems, (ionic solutions comprising vanadium salts or iron-chromium salts), reversible fuel cells with gaseous reactants, and hybrid flow batteries (e.g., metallic anodes as in Zn-Br, or Zn-air), are being developed. The Vanadium Redox Battery is perhaps the most developed flow battery, but still has several deficiencies, such as: i) Low energy densities, (~ 25 Wh/kg, and 20-30 Wh/liter, which is about 1/5th of conventional Li-ion batteries), ii) Low efficiency of 60%, and iii) Non-economic cost (~ 6 -20 times the target of \$100/kWh, mainly due to high cost of Vanadium reactants and Nafion membranes. To mitigate these issues, new chemically-stable redox couples, with high cell voltage (possible only in non-aqueous electrolytes) are desired and being proposed here to improve energy and power densities.

Anticipated Benefits

None.



Project Image New Alkali Metal Flow Battery for Terrestrial and Aerospace Energy Storage Applications

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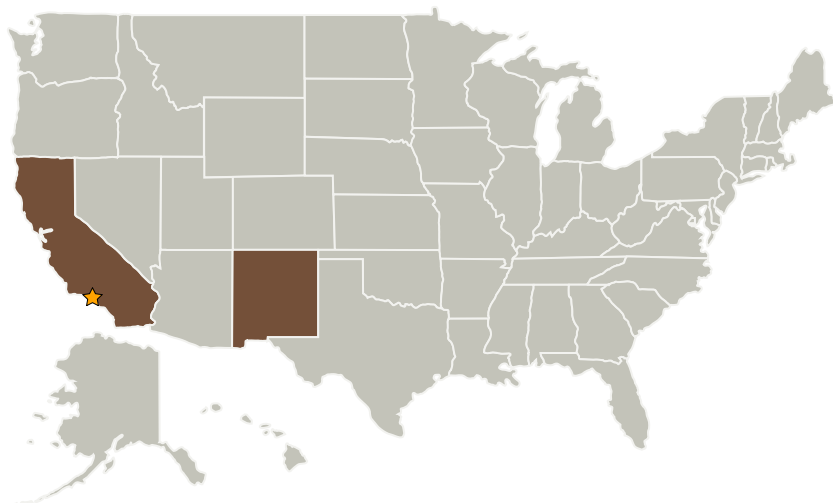
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California

Co-Funding Partners	Type	Location
California Institute of Technology(CalTech)	Academia	Pasadena, California
EnerVault Corporation	Industry	Sunnyvale, California
Sandia National Laboratories(SNL)	R&D Center	Albuquerque, New Mexico

Primary U.S. Work Locations	
California	New Mexico

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

Center Innovation Fund: JPL CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Fred Y Hadaegh

Project Manager:

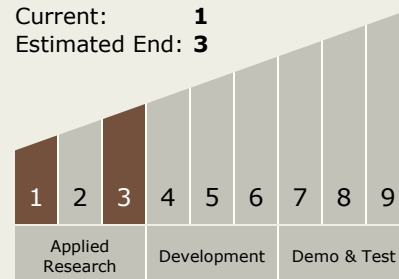
Jonas Zmuidzinas

Principal Investigator:

Ratnakumar V Bugga

Technology Maturity (TRL)

Start: 1
Current: 1
Estimated End: 3

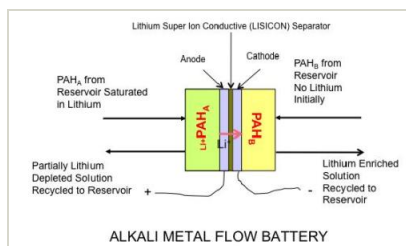


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Images



68.jpg

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(<https://techport.nasa.gov/image/1162>)

Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
 - └ TX03.2 Energy Storage
 - └ TX03.2.1 Electrochemical: Batteries